Integration of MES and ERP

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INTRODUCTION

In the present manufacturing paradigm, manufacturing execution systems (MESs) play a significant role in effective manufacturing management. Offered software solutions simultaneously close the gap between Enterprise Resource Planning (ERP) systems and production equipment control or SCADA (Supervisory Control and Data Acquisition) applications. Current ERP systems usually contain modules for material management, accounting, human resource management and all other functions that support business operations. In the past years, the role of ERP has been extended to cross-organizational coordination. Nowadays, as optimization of production activities is increasingly topical, a cooperation of ERP and MES becomes a serious concern of manufacturing managers.

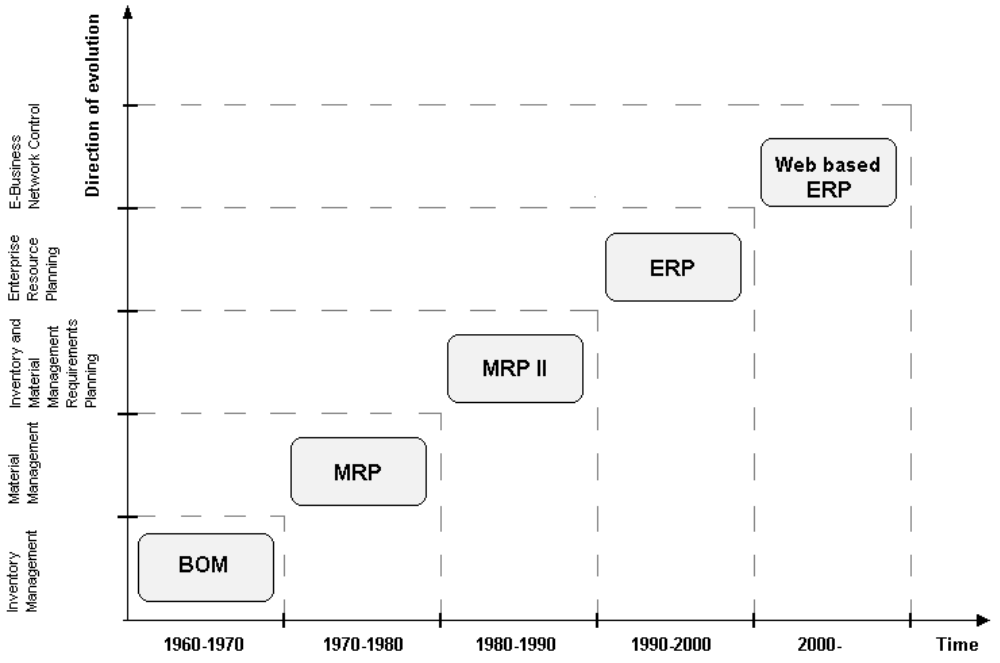
BACKGROUND OF ERP AND MES EVOLUTION

From a historical perspective, the infiltration of information technology into manufacturing technology was conditioned by the development and advancement of host mainframe computing in the 1950s and 1960s. It gave manufacturers the ability to capture, manipulate, and share information and automate calculation and analysis in order to support design of increasingly complex and capable products. Simultaneously, in the framework of manufacturing management, an inventory control took on great importance and most of the software in the 1960s was developed for this purpose. Typically, inventory control was handled by a tool called BOM (bill of materials) processors, which were used as a means to represent process plans. The focus shifted in the 1970s to Material Requirement Planning (MRP) as the complexity of manufacturing operations increased. This managerial instrument enabled financial managers both to view and control their business processes much more closely. The tools to automate business processes were enhanced by adding further functionalities to meet the increased requirements. Subsequently, in the 1980s the term Manufacturing Resources Planning (MRP II) became popular. An MRP II presented extension of MRP functions to achieve integration of all aspects of the planning and control of the personnel, materials and machines (Kimble & McLoughlin, 1995). Following, solutions that are marked by acronym ERP were performed in the early 1990s. An ERP system can be defined as an integrated information processing system supporting various business processes such as finance, distribution, human resources and manufacturing (Choi & Kim, 2002). The newest version ERP II has been much publicized by the Gartner group (Mohamed & Fadlalla, 2005). Fundamentally, ERP II signals a shift in traditional ERP applications from focusing on internal data gathering and management process information to partners, vendors and customers externally via the Web (Farver, 2002). The overall view on evolution of ERP system is shown in Figure 1. Initially, this concept attained a huge popularity among manufacturers, but as the scope of managed systems increased, the ERP system was not suitable for controlling activities on the shop floor level. For this purpose, a new tool of manufacturing management called Manufacturing Executive System was evolved and utilized during the 1990s. There is more interpretation of MES depending on different manufacturing conditions, but the common characteristic to all is that an MES aims to provide an interface between an ERP system and shop floor controllers by supporting various "execution" activities such as scheduling, order release, quality control, and data acquisition (MESA #6, 1997). In a context of the MES development and deployment, it is important to point out that Manufacturing Execution Systems were originally designed to provide first-line supervision management with a visibility tool to manage work orders and workstation assignments. Consecutively, MES expanded into the indispensable link between the full range of enterprise stakeholders and the real-time events occurring in production and logistics processes across the extended value chain (McClellan, 2004).

INTEGRATION OF ERP AND MES

Manufacturing execution systems besides their typical functions were developed and used also as the interface between ERP and process control, because it was generally recognized that ERP systems weren't scalable. The seamless connections often required skilled coding to connect to ERP and process control systems (Siemens Energy & Automation, Inc., 2006). Today, the availability of Web-based XML communications successfully bridges the gaps between MESs and ERP systems. Built on XML, the B2MML (business-to-manufacturing markup language) standard specifies accepted definitions and data formats for informa-

Figure 1. The evolution of ERP systems



tion exchange between systems, and facilitates information flow and updates between ERP and manufacturing execution systems. It also instigated redefinition of the role of the MES. The ISA SP-95 model (see Figure 2) breaks down business to plant floor operations into four levels.

Levels 1 and 2 include process control zone. The MES layer consists of manufacturing management, dispatching production, detailed production scheduling, reliability assurance, and so forth. A point of debate about MES functionalities is connected with more aspects like different types of manufacturing and others (Modrák, 2005). Level 4 corresponds to the business planning and logistics.

The goal of ISA-95 standard was to reduce the risk, cost and errors associated with implementing interface between ERP and MES. The ISA-95 "Enterprise - Control System Integration" is a multipart series of ANSI/ISA standards that define the activity models and interfaces between manufacturing functions and other enterprise functions. Parts 1 (Models and Terminology), parts 2 (Objects Attributes) and part 5 (Business to Manufacturing Transactions) define the exchange of production data between business and plant systems. B2MML provides a schema implementation of the ANSI/ISA-95 and represents an independent technology implementation of this standard. B2MML has been developed

Figure 2. Position of MES in the hierarchy of IT systems